CA 64-20
6 February 1964

U. S. Government
Washington, D. C.

STAT Attention:

Subject:

Gentlemen:

In accordance with the oral request for a list of deliverable equipment under Phase II of the subject contract and a list of test equipment required by the customer, the following is submitted:

Deliverable to Customer - Phase II Linear Phasolver Breadboard Model

Driver, Assy. of	(no number yet assigned)
Coupler - Guide, Assy. of	(no number yet assigned)
Box Assy.	1000-2471
B&S Electronic Gage	B&S 599-982
Shutter Release Cable	9330-0001
1 Set of 14 Gage Blacks in boxes	No number required
1 Electronics Package	(no number yet assigned)
1 Power Supply Assembly	(no number yet assigned)

Unit Customer Required to Purchase for Demonstration Capability

1 Hewlett Packard Model 5275A Time Interval Counter

If additional information is desired, please contact the undersigned.

Very truly yours,

STAT

Manager of Contracts

STAT cc:

STAT

SIXTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

15 January 1964

SUMMARY

A. The following items were accomplished during this report period:

1. The loft data for the driver master has been generated and the purchase order for the fabrication of the driver master was placed with [redacted] The package containing corrected drawings with the loft data was mailed to [redacted] on 15 January 1964.

2. Preliminary tests of the voltage controlled oscillator have been conducted. The results indicate that the purchased unit meets the requirements for this system. A voltage controlled frequency change of ±0.1 per cent was obtained; also frequency stability of about 0.001 per cent over a few degrees ambient temperature variation was measured.

B. Potential Problem Areas:

Peak, short term, manpower requirements during this report period within [redacted] have delayed the reed holder design, circuit design modification of the drive and pre-amplifiers for 10 kcs operation, box assembly tests, and completion of drawing corrections for the driver master. There is schedule slack for these items except the drawing corrections. The drawing corrections were completed on 15 January and mailed to [redacted] This task paces the start of [redacted] effort on the driver master. Manpower is scheduled during the early part of the next report period to start the other assignments.

C. Driver Master and Part Fabrication:

A written bid for driver master fabrication was finally obtained from [redacted] was selected for this task as noted in the preceding progress report. [redacted] bid was high and did not contain a breakdown between master and part fabrication. Quick customer approval was obtained, and the purchase order to [redacted] was placed. A firm bid has been obtained from [redacted] to fabricate the part, with glass blanks and master plate furnished by others. It is planned to place this purchase order during the next report period.

D. Voltage Controlled Oscillator:

A voltage controlled oscillator is incorporated in the system to allow correction for the scale factor error in the coupler, and the temperature coefficient effect on the scale factor from expansion or contraction of the coupler glass plate. This oscillator supplies a stable frequency of 1 Mc and allows a manually adjustable change of ±0.1 per cent. This frequency is counted down to a frequency of 10 kcs which is used to drive the Phasolver patterns. Thus the period of the energizing frequency is varied ±0.1 per cent which effectively provides an electronic scale factor adjustment in the system.

Estimates of the above mentioned scale factor error magnitude are:

1. Coupler manufacturing error of ±0.001 inch in 10 inches or ±0.01 per cent.

2. Using an estimated temperature change during tests of about ±10°F and a glass coefficient of about 5 ppm/°F (actually, borosilicate is closer to 3.5 ppm/°F) yields a value of ±0.005 per cent.

By simple addition these two scale error components will be ±0.015 per cent. The adjustment capability of ±0.1 per cent appears to be entirely adequate.

Preliminary tests have been completed which verify an adjustable frequency range of ±0.1 per cent and a frequency stability of about 0.001 per cent over a few degrees ambient temperature change. The unit is manufactured by Greenray Industries, Inc., model number 258000. Vendor specifications include: frequency output 1 Mc ±0.1 per cent with frequency stability of 0.005 per cent from 0 to 50°C; output frequency deviation of ±0.1 per cent with a 0 to 10 VDC control voltage input.

E. Work Planned During Next Report Period

1. Accomplish reed holder design and start fabrication.

2. Start trial box assembly No. 2.

3. Place order for driver part fabrication with [redacted] STAT

STAT

FIFTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

12 December 1963

SUMMARY

A. The following items were accomplished during this report period:

1. The pantograph reed assembly and voltage controlled oscillator have been delivered.

2. Most of the electronic materials required for the Phase II system have been ordered. The remaining materials will be ordered after completion of the drive amplifier and preamplifier circuit modifications for 10 kcs operation.

3. The purchase orders for the coupler, driver, and guide rail glass blanks have been released. The vendor is [ ] The coupler STAT
pattern and part fabrication have been ordered. The vendor is [ ] STAT
STAT [ ] The internal purchase requisition for the driver master has been approved, but placement of this order requires prior customer approval. Order placement date cannot be accurately predicted. An estimated date of 23 December 1963 has been used in the enclosed master schedule.
STAT The selected vendor is [ ]

4. A master schedule for the remainder of the program has been prepared. Estimates were used to predict the issuance of the purchase order for the driver master and the fabrication time interval of the driver part. With these assumptions it appears that the program completion has slipped three weeks to about 20 July 1964 instead of the originally scheduled completion of 30 June 1964. Every attempt will be made to bring the end date back into line with the original schedule.

B. Potential Problem Areas:

The procurement of the fabrication of the driver continues to be a
STAT problem. [ ] have verbally stated that they are willing to bid this fabrication. We are presently awaiting their formal bid, but additional alternate sources will be investigated for this task.

We were not able to obtain a written bid from [ ] on the driver STAT
master generation. They simply did not respond to the many calls, wires, and letters that were sent to them. In the interest of the project schedule

STAT it was decided to select [redacted] for this task. This work is of a very special nature, and it is hoped that the availability of only one source will not jeopardize allowance of the purchase order.

C. Schedule:

As seen from the enclosed schedule, there is one critical path (no slack) and it contains the generation of loft data, driver pattern generation, driver fabrication, and pattern test measurements events to the week of 20 April 1964. Subsequent to this time the final test fixture assembly, system test, and final report events will occur. All other paths have slack, and no major problems are anticipated in these areas.

D. Work During Next Report Period:

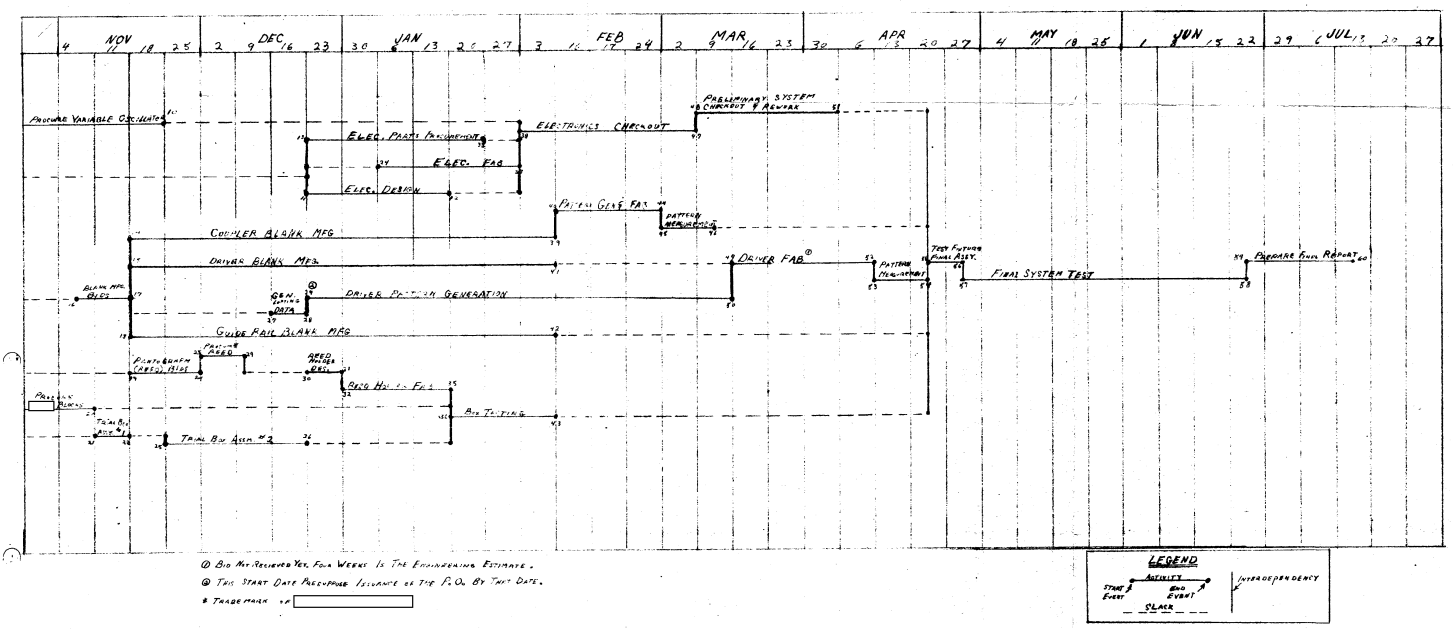
1. Generate the loft data for the driver master and place the purchase
STAT order with [redacted] for the fabrication of driver master.

2. Start and complete the reed holder design.

3. Start the reed holder fabrication.

LINEAR PHASOLVER* SYSTEM
MASTER SCHEDULE

11 DEC. 1963



① BID MAY RECEIVED YES, FOUR WEEKS IS THE ENGINEERING ESTIMATE.

② THIS START DATE PRECIPITATE ISSUANCE OF THE P.O. BY THAT DATE.

* TRADEMARK OF [redacted]

LEGEND

ACTIVITY — START EVENT — END EVENT

INTERDEPENDENCY

SLACK

STAT

STAT

63-603

STAT [redacted] [redacted] STAT

FOURTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER* SYSTEM

14 November 1963

[redacted] ILLEGIB

SUMMARY

A. The following items were accomplished during this report period:

1. The brief Phase I Summary Report was completed and sent to the customer on 21 October 1963.

2. The Phase II electronics system design was completed.

3. The first trial assembly of the Phase II mechanical subsystem was started and completed.

4. The following bids have been received –

Item	Vendor and Delivery Dates
a) Driver and coupler glass blanks	[redacted] 12-16 weeks STAT [redacted] not given but requested STAT
b) Coupler pattern (complete part to be fabricated with glass blank furnished by others)	[redacted] 6-8 weeks ARO or 3 weeks after receipt of blanks STAT
c) Driver master only	[redacted] 12 weeks ARO STAT
d) Driver master and part fabrication	[redacted] 26-40 weeks STAT (telephone bid only - awaiting breakdown details)

STAT 5. [redacted] has been selected, based on vendor bids, to supply the driver and coupler glass blanks. [redacted] has been selected to supply the STAT coupler pattern and fabricate part with glass furnished by others.

B. Potential Problem Areas:

At present no bid is available for fabrication of the driver. We have STAT requested [redacted] to consider fabrication of this part with the master and glass plate furnished by others. Also, we are awaiting [redacted] written STAT bid with the requested breakdown, and will verify if [redacted] is willing to STAT fabricate the driver with the master and glass plate furnished by others. STAT [redacted] has bid the driver master but has not bid the fabrication of this part.

* Phasolver is a trademark of [redacted] STAT

MECHANICAL ASSEMBLY

All parts were received including dummy glass plates. The feasibility of mounting these plates in the box assembly using a special optical wax was successfully demonstrated; but considerable handling of the plates was required during the alignment and setting process because of the material setting characteristics. Use of plaster will be investigated for this assembly phase, since it is desired to keep the handling of the actual glass plates with patterns to a minimum during this phase.

MECHANICAL COMPONENTS

Reed assembly of the pantograph mechanism has been ordered from [redacted] Present delivery date is 10 December 1963. The [redacted] blocks have been delivered.

PROCUREMENT OF GLASS PARTS

As stated in the summary, bids have been received from [redacted] and [redacted] for the coupler and driver glass blanks; [redacted] for the driver master only, no bid on fabrication of the part; [redacted] telephone bid on driver master and part fabrication, but no breakdown on individual units. We are presently awaiting their breakdown. [redacted] has been selected to supply the driver and coupler blanks. [redacted] has been requested to bid on fabrication of the driver assuming the glass blank and master is furnished by others. [redacted] breakdown bid will be evaluated with [redacted] prior to vendor selection.

SYSTEM DESIGN

Figure I is a simplified block diagram of the Phase II system. A 10 kcs drive frequency has been selected. The 100 Mcs true time interval counter will be used. The digitization of the drive period is 100 μsec/. 01 μsec = 1×10^4 parts. The drive period is equivalent to one pole pair span, which is 1 mm. Therefore, the quanta resolution of the system will be 1 mm/10^4 or 0. 1 micron.

ELECTRONIC COMPONENTS

The 1 Mc voltage controlled oscillator (for scale factor correction) delivery date is 18 November 1963. The revised design of the basic drive amplifier for 100 kcs operation (present amplifiers use 6. 25 kcs) has not yet started.

WORK DURING NEXT REPORT PERIOD

1. Place all purchase orders for masters, blanks, and part fabrication.

2. Continue evaluation of mechanical assembly using plaster as a mounting medium.

3. Start 10 kcs drive amplifier design modification. Order remaining electronic components.

4. Generate revised schedule and mileposts for remainder of program.

YB/ek

Approved For Release 2006/03/16 : CIA-RDP78B04770A001800010062-5

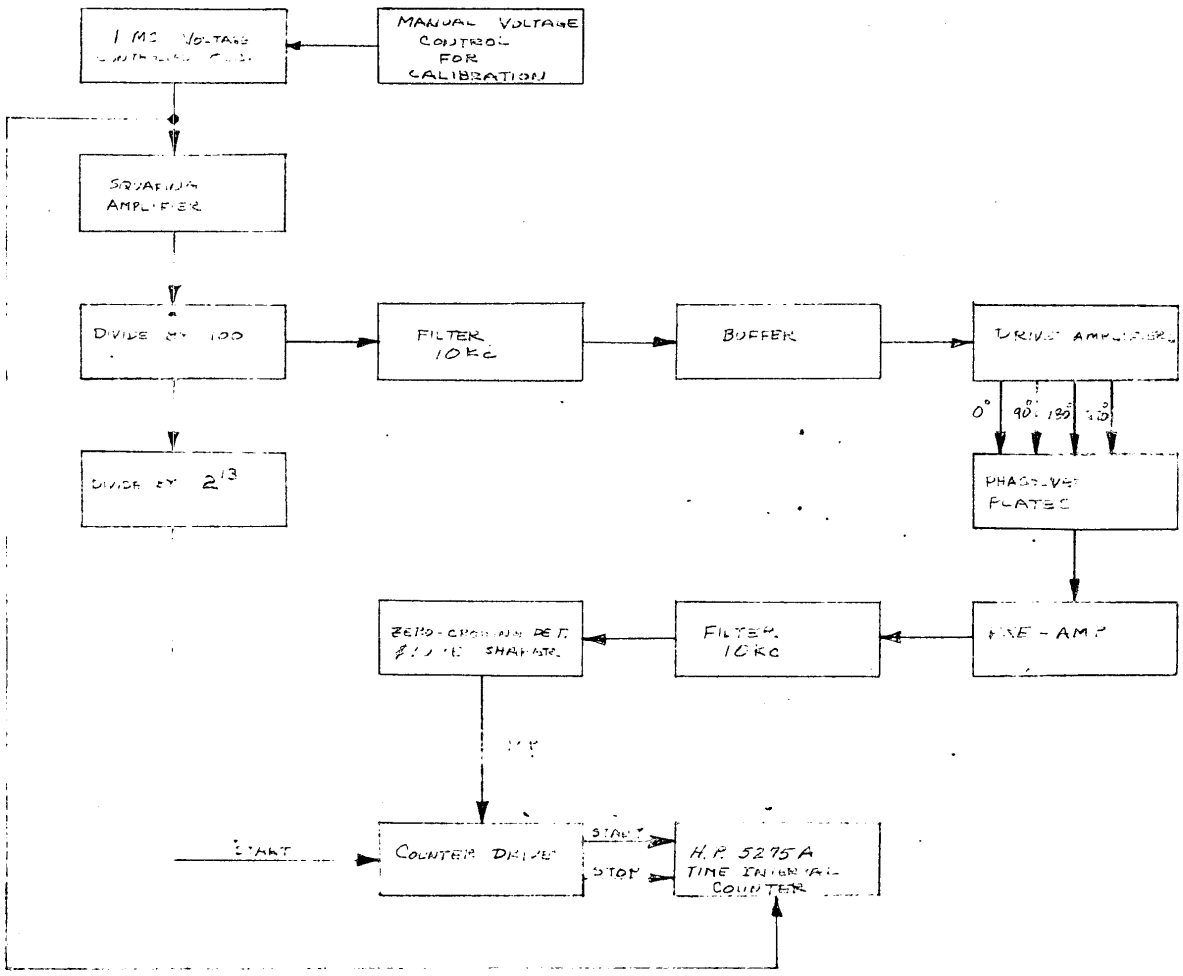


Figure 2

STAT BY
CHKD BY
DATE 10/22/62
SUBJECT MJO
JOB NO.
SHEET NO. 1 OF 1
BLOCK DIAGRAM, LINEAR PHASE, PHASE IT

63-444

THIRD MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER* SYSTEM

10 October 1963

SUMMARY

The following items were accomplished during the month of September 1963:

1. Electronics checkout for the Phase I feasibility model.
2. Successful demonstration of the Phase I model for the customer on 1 October 1963.
3. Review of the preliminary patterns by the potential vendors, [redacted] STAT
STAT [redacted] reviewed our requirements with these people during a trip taken for this purpose.
4. Formal release of the requests for quotation on the glass blanks and patterns for the Phase II model.

PHASE I FEASIBILITY DEMONSTRATION

During this period the electronics for Phase I were completed and checked out. Fragility of the old driver pattern produced several "loss of contact" malfunctions during the checkout, and a new pattern was deposited on a blank, using the original master, as a backup. However, it was not necessary to resort to this backup prior to the demonstration.

On 1 October 1963 the demonstration was successfully performed for the customer. A monotonically increasing or decreasing count as a function of displacement was demonstrated, as observed by two true time interval counters (the 100 Mc counter was used on the fine channel; the 10 Mc counter was used to count coarse counts).

PHASE II MECHANICAL ASSEMBLY

Box Assembly 1000-2471 is complete and all detail drawings will be released the second week in October. Dummy glass parts are expected momentarily. We expect a trial assembly to be made in the third week of October.

* Phasolver is a trademark of [redacted] STAT

DESIGN AND PROCUREMENT OF GLASS PARTS

As a result of conferences with potential vendors for these parts, some design changes were made in the driver.

All drawings for both blanks and finished parts have been checked and released; and RFQ's have been sent to both blank manufacturers ([redacted] STAT
STAT [redacted] and to vendors for pattern
generation and application [redacted] STAT

The only design problem remaining in this area is the generation of the loft data. This will be done after a vendor has been selected so that the numbers will be compatible with his equipment and the size at which he chooses to make the original artwork.

PANTOGRAPH MECHANISM

Negotiations are still in progress with [redacted] STAT
So far, we have determined that at least part of this mechanism can be gotten from them at a reasonable price.

STAT [redacted] BLOCKS

A purchase order has been let to [redacted] for the set of blocks STAT
needed. Delivery has been promised for 21 October, a great improvement over what we had expected.

PHASE II SYSTEM DESIGN

The requirements for the voltage controlled oscillator have been defined and an available unit has been ordered for evaluation. The vendor delivery date is 18 November 1963.

The mechanical design of the pantograph mechanism is continuing, and part of this mechanism will be available from [redacted] as reported above. STAT

PHASE II SCHEDULE

It appears that a serious Phase II slippage will occur due to anticipated long delivery of the master driver pattern from the vendor. No preliminary delivery information on the driver could be obtained from [redacted] STAT
STAT [redacted] indicated about four to six weeks delivery of the completed coupler. It is expected that replies to our requests for quotation will be available during the next report period. At this time a revised schedule for Phase II

will be generated based on vendor commitments for the blanks, driver, and coupler masters.

WORK DURING NEXT REPORT PERIOD

1. The brief Phase I summary report will be completed. This report will include a description of the test and conclusions, photographs of the test setup, and drawings of the equipment pertinent to Phase I.

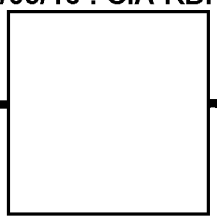
2. The Phase II electronics system design will be completed.

3. The initial trial assembly of the Phase II mechanical subsystem will be started.

4. It is expected that the vendors bids on the blanks, driver and coupler masters, and finished parts will be received during October. Every effort will be made to place the purchase orders during October. Two weeks have been allocated for vendor response and one week has been allowed for bid evaluation.

STAT [redacted]

Project Manager



SECOND MONTHLY PROGRESS REPORT

MOD 933 PHASOLVER*SYSTEM

10 September 1963

SUMMARY

Progress during the month of August 1963 was made primarily in the following areas:

1. Completion of the mechanical test fixtures for the feasibility demonstration of Phase I.
2. Fabrication of the electronics for use in the demonstration of Phase I.
3. Completion of the new Linear Phasolver pattern specifications and submission to vendors for bid.
4. Design and partial fabrication of mechanical assembly for Phase II.
5. Continuation of Phase II system design.

MECHANICAL TEST FIXTURE FOR FEASIBILITY DEMONSTRATION

This fixture has been completed and is ready for checkout with the electronics.

PHASE I ELECTRONIC CIRCUITRY

The fabrication of this circuitry has been delayed due to procurement problems. Actual fabrication was not able to start until 28 August 1963. The revised completion date is 16 September 1963. In order to accelerate the system test phase, the mechanical fixture will be given a preliminary checkout with existing in-house electronics and commercial test equipment. This should reduce the system testing phase by one week.

NEW LINEAR PHASOLVER PATTERN

The initial pattern specifications have been completed and submitted for bid. From discussions with our vendors, we expect replies and questions by 20 September 1963. A full-size drawing of the final driver pattern is included with this report. As yet, we have no delivery information on this task. In addition, required tolerances on pattern dimensions are being prepared from earlier work on pattern errors.

* Phasolver is a trademark of

PHASE II MECHANICAL ASSEMBLY

Most of the mechanical assembly is designed and portions are on order. We expect to complete the design by 16 September 1963 with the assembly complete by 7 October 1963. Dummy plates have been ordered to check out the mechanical fixture prior to assembly with the final plates. This dry run should significantly improve the final mechanical checkout schedule.

PHASE II SYSTEM DESIGN

The design of the electronics package for Phase II is continuing. Major attention this month has been on the scale factor adjustment circuitry.

One of the most pressing problems in Phase II is the method of measuring the travel of the Phasolver plates. We intend to use gage blocks to position the Phasolver plates accurately. For diagnostic purposes, we require many non-standard gage blocks so that we can move the Phasolver through known portions of different pole pairs throughout the length of travel. For example, we may wish to examine the output at 25mm; 25.125mm; 25.250mm; 25.375mm, etc., through 26mm; and again at 50mm; 50.125mm, etc., through 51mm; and again at 75mm; 100mm, etc., throughout the 10 inch length of travel. The tolerance of "AA" quality gage blocks is ± 2 microinches per inch in lengths greater than one inch. This can produce an error in position of up to ± 20 microinches (± 1/2 micron) in ten inches. The choice of gage blocks required which will minimize the total number and still produce sufficient flexibility is being made on the basis of delivery, price and handling ease.

The force applied to the gage blocks will be transmitted through a pantograph mechanism which will insure correct alignment of the gage blocks in the fixture. At present, we have not been able to locate a source for this mechanism, although we have contacted vendors who manufacture this type of mechanism for their own products. As yet, we have not received any replies.

WORK DURING NEXT REPORT PERIOD

1. Completion of fabrication and checkout of the electronics for Phase I and start of the feasibility testing.

2. Completion of the mechanical assembly design of Phase II. We expect the fabrication to be 80% complete by the end of the report period.

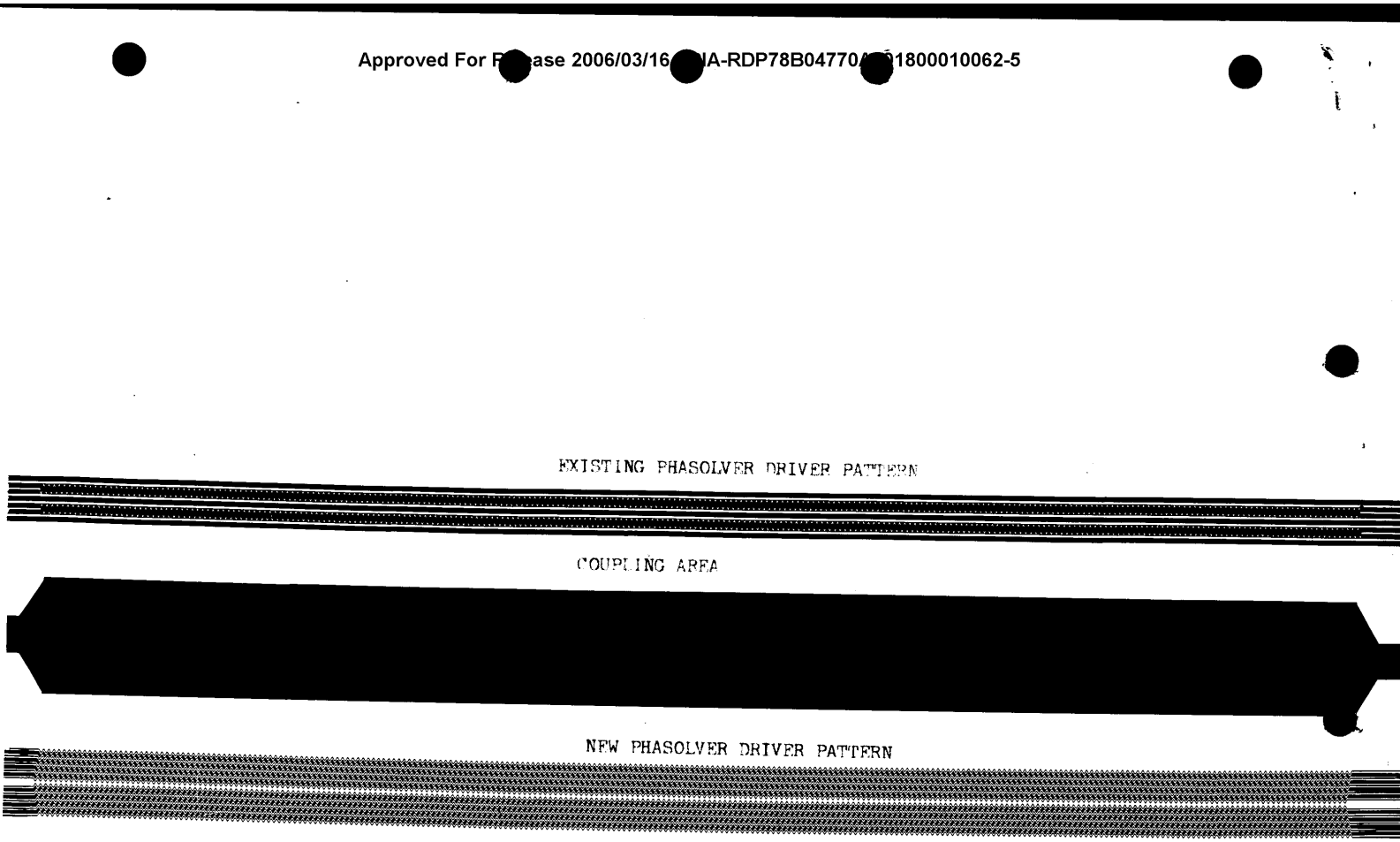
3. Continue negotiations with vendors on the pattern manufacture. We hope to be able to award a contract during this period.

4. Continue the design of the electronics for Phase II.

STAT [redacted]

Project Manager

EG:lr
Att:



DRIVER PATTERN

MODEL 933 PHASOLVER

(ACTUAL SIZE)

[redacted]

FIRST MONTHLY PROGRESS REPORT

933 PHASOLVER*SYSTEM

10 August 1963

INTRODUCTION

The Model 933 Phasolver program contains two phases that run concurrently. The duration of Phase I is 12 weeks; the duration of Phase II is 48 weeks. The program started on 17 July, 1963. The completion date of Phase I is 14 October, 1963. The completion date of Phase II is 22 June, 1964.

In Phase I, a feasibility demonstration of a linear Phasolver will be made to show that the basic Phasolver principle can be applied to the measurement of linear displacement. The demonstration will include, but will not necessarily be limited to, tests that verify a monotonically increasing count with displacement.

In Phase II, a developmental model of a linear Phasolver will be designed, fabricated, and tested. The design accuracy goal is ±1.0 micron with a design resolution goal of 0.25 micron in a travel of not less than 10 inches. Tests will include, but will not necessarily be limited to, accuracy and resolution tests over the specified travel at laboratory ambient temperature conditions.

The program schedules for Phase I and Phase II are included in this report.

SUMMARY

Effort during the month of July, 1963 was made primarily in the following areas:

1. Preparing the in-house linear Phasolver plates and the mechanical test fixtures for the feasibility demonstration of Phase I.
2. Designing electronics for use with these Phasolver plates for the demonstration in Phase I.
3. Designing a new linear Phasolver pattern for Phase II.
4. Overall system design for Phase II.

* Phasolver is a trademark of [redacted]

PREPARING TEST FIXTURE FOR FEASIBILITY DEMONSTRATION

The Phasolver plates for Phase I have been repaired for the demonstration. Fortunately, a coupler plate was located which eliminated the necessity of fabricating a new coupler. A careful examination of these patterns shows a large variation in the linearity of the pattern over its length. Therefore, the linear motion in the demonstration will be restricted to between 1/2 and 1 inch so that it will remain in the most linear portion of the pattern. This limited motion is sufficient to demonstrate a monotonically increasing count over a minimum of six fine pattern pole-pairs.

A simple fixture for holding these plates has been designed and is now being fabricated. The estimated completion date of the fixture is 19 August, 1963.

PHASE I ELECTRONIC CIRCUITRY DESIGN

All of the required electronics circuitry for Phase I has been designed, and all parts have been ordered. This circuitry consists of a countdown chain from a crystal clock, driving electronics for both channels of the Phasolver, and special circuits designed to mate this equipment to commercial time-interval counters. A block diagram of the Phase I electronics is included with this report. Most of the analog electronic circuitry used in Phase I is owned by [redacted] and will not be suitable for the more stringent requirements of Phase II. However, almost all of the circuitry purchased for Phase I will be used during Phase II. The estimated date for completion of the electronics is 9 September, 1963.

STAT

NEW LINEAR PHASOLVER PATTERN

A new pattern has been designed for the linear Phasolver which embodies the latest results from the Phasolver error analysis currently being made. A design review has been held and the pattern specifications are now being written for submission to the vendor for lofting. The approved pattern consists of two sets of four sinusoidal areas in quadrature arranged symmetrically to minimize the effects of skew. In order to evaluate the pattern quantitatively, we plan to loft the existing Phasolver pattern to the same scale and compare the performance of each. An analysis is being made on the new pattern prior to lofting to determine its theoretical sensitivity to skew.

This phase of the program is behind schedule. Because of the magnitude and importance of this task, great care is being exercised. It is anticipated that some of this time may be regained during the manufacture of the master and the plates.

PHASE II SYSTEM DESIGN

The design of the electronics package for Phase II has started. The problem areas being investigated are those associated with the scale factor adjustments. Present manufacturing tolerances are such that we cannot hope for an accuracy in lofting of the pattern of better than ±8 microns in 10 inches. Therefore, we expect an error in the overall length of the Phasolver pattern. The scale factor adjustment will permit an electrical adjustment of the length of the pole pair to compensate for this error.

Portions of the mechanical assembly for Phase II have been submitted to vendors for bid. No replies have been received. Design of the mechanical fixture is proceeding along with the pattern design. One problem area is routing of conductors from the pattern around the plate to a convenient location for wiring. It is impractical to use our present methods for connecting to pattern since the ends of the pattern are available and will provide a simpler and more reliable manufacturing process resulting in a significant improvement in the delivery schedule of the final plate.

WORK DURING THE NEXT REPORT PERIOD

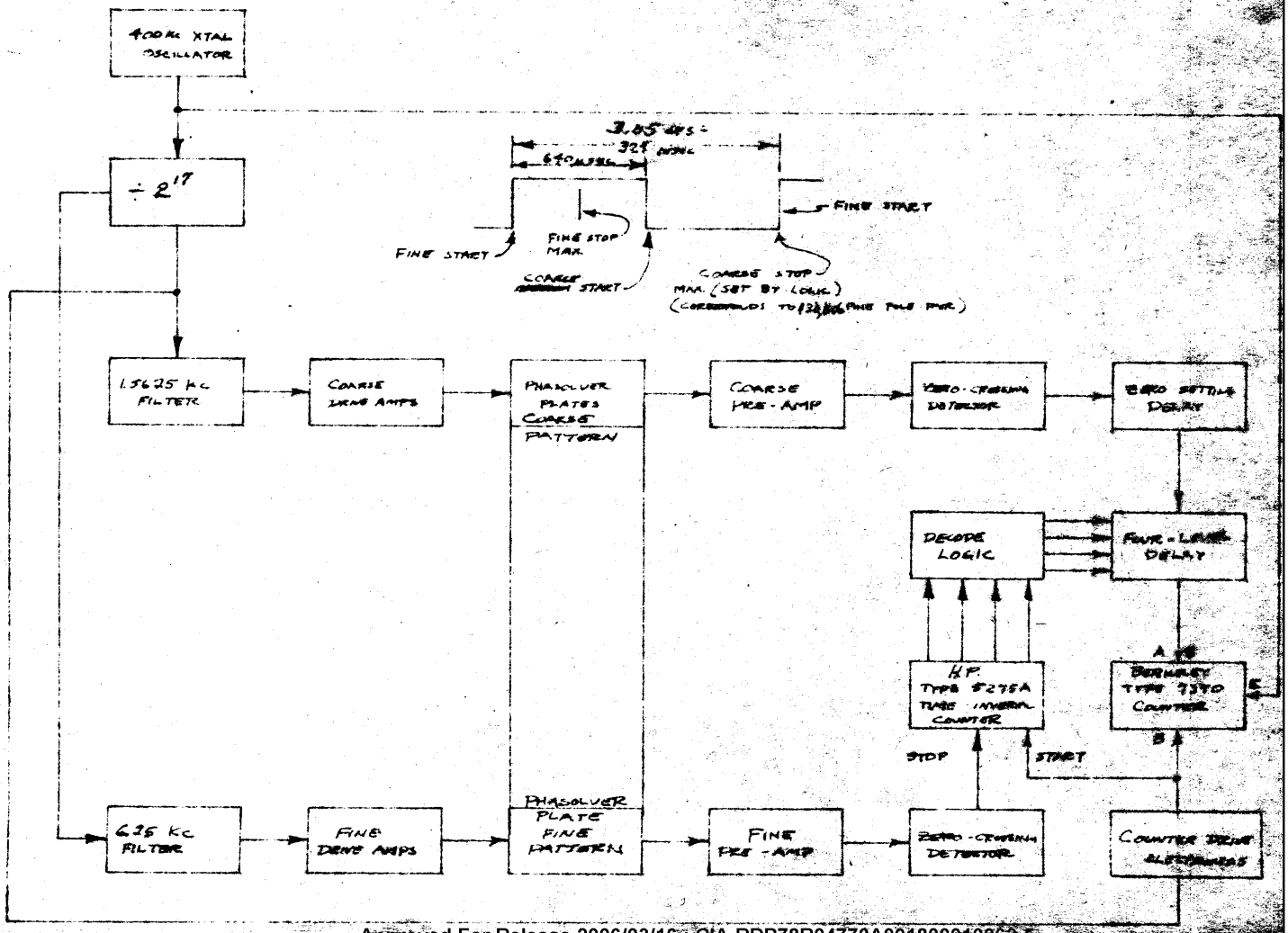
1. We will finish the mechanical fixture for the demonstration in Phase I. We also expect to finish fabricating and will start checkout of the electronics package.

2. We will finish the new pattern design and will submit it to vendor for bid. We hope to be able to award a contract for the lofting during this period.

3. We expect the mechanical design for the fixture of Phase II to be complete during this period. This may be delayed, however, due to the delay in the design of the master pattern.

STAT

Project Manager



STAT

SYSTEM Model 933 | DATE 7/12/63

M.O 342 | ORIGINATOR

LINEAR PHASOLVER PROGRAM SCHEDULE - PHASE I

YEAR 1963

TASK DESCRIPTION	MONTH	July			August				September				October			
	Week	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28
1. Rework Driver		△														
2. Fabricate Coupler			△													
3. Design Fixture for Coupler		△														
4. Fab. Fixture for Coupler			△													
5. Design and Coordination of Final Setup				△												
6. Testing									△							
7. Report												△				
8. Electronics Package																
a. Design Configuration		△														
b. Procurement of Parts			△													
c. Wiring and Stuffing				△												
d. Test					△											

STAT

SYSTEM Model 933 | DATE 7/12/63

MJO 342 | ORIGINATOR

LINEAR PHASOLVER PROGRAM SCHEDULE - PHASE II

TASK DESCRIPTION	Day Week	1963 July	August	September	October	November	December	1964 January	February	March	April	May	June
		22 29	5 12 19 26	2 9 16 23 30	7 14 21 28	4 11 18 25	2 9 16 23 30	6 13 20 27	3 10 17 24	2 9 16 23 30	6 13 20 27	4 11 18 25	1 8 15 22 29
1. Pattern Design													
2. Artwork and Master Mfg.													
3. Blank Mfg.													
4. Plate Mfg.													
5. Mechanical Design													
6. Drafting													
7. Mechanical Fabrication													
8. Electronic Gage Procurement													
9. Check of Coupler Scale													
10. Gage Block Purchase													
11. Final Assembly													
12. Mech. Test and Checkout (rework if necessary)													
13. System Tests													
14. Final Report													
15. Monthly Progress Reports													